U.S. Fish & Wildlife Service

Abernathy Fish Technology Center Newsletter

Volume 9, Number 5, September/October 2017

In this issue:

Serving the Pacific and Pacific Southwest Regions

Spotlight on the Ecology Program

Providing information to facilitate execution of the FWS Mission

Native bull trout (Salvelinus confluentus). The dorsal fin of a non-native brook trout (*Salvelinus fontinalis*) is visible behind the bull trout.

The Quantitative Ecology & Technology (QET) Program conducts applied research to support conservation and management of aquatic resources. Recent and current projects deal with many key issues in fishery conservation, such as the role of hatcheries in conservation and differences between wild and hatchery salmon, effects of migration barriers or loss of connectivity, invasive species, climate change, and how to make decisions when hard data are sparse. Types of questions we work on include:

What are the differences between Pacific salmon reared in a hatchery vs. in the wild? As a way to mitigate for fish losses from habitat destruction, fish passage barriers, and over-harvest, millions of Pacific salmon are reared in and released from hatcheries. Unfortunately, Pacific salmon reared in hatcheries can become different relative to wild fish, which can reduce their usefulness as a mitigation tool. For over a decade QET biologists have investigated ecological differences between wild and hatchery steelhead. Ecological research has focused on studying feeding behavior and behavioral interactions between juveniles during freshwater residence, as well as using mark-recapture methods and population modeling to evaluate potential differences in distribution, survival, and migration timing.

Spotlight on the Ecology Program (cont.)

How do human-made barriers affect fish populations? When fish are not able to move in necessary habitats, individuals may not grow as large or survive as well and as a consequence, their populations may decline. We have investigated a number of ways that human-caused barriers affect fish populations. For example, to understand how irrigation headgates affect juvenile and adult salmon during migration, we used mark-recapture-resight methods and a suite of fixed and mobile antennas to estimate survival and migration delay. To understand how isolation time and habitat size influences occurrence of stream-resident trout isolated above culverts, we used presence/absence sampling to develop a model for extinction probability. Information from these studies can be used by managers to operate irrigation structures to reduce mortality within sensitive populations or to prioritize habitats or populations for conservation actions.

What can be done to limit ecological damage from non-native species? The introduction and spread of non-native aquatic species can have profound consequences for aquatic habitats. From hybridization between trout species to ecosystem-level changes caused by zebra and quagga mussels, addressing threats and impacts from non-native species are a challenge to natural resource managers. In many cases, it is impossible to completely remove a non-native species once it is well-established. Population control may be possible in some settings, and program staff have used modeling, technological, and ecological field studies to investigate the decision space. Currently, we are trying to understand the relationship between biomass of carp and presence/abundance of submerged aquatic vegetation of interest to biologists seeking to reduce carp populations and provide better habitat for resident and migratory birds.

How will climate change affect fish populations and how we manage them? The most direct effect of climate change on fish populations is expected to be from changes to water temperature and water availability. To inform how changes in temperature and stream flow might affect fish populations of interest, we have built probabilistic models and modeling frameworks that use future climate data as inputs, and generate predictions for habitat suitability, occurrence of target species, or production. Managers can use these predictions to inform current and future conservation actions, so that the decisions are robust to anticipated climate change.

How can managers make better decisions when data are sparse? Natural resource managers often face hard decisions with uncertain outcomes. Empirical data may not be available or the question may be very complex or have many potential outcomes. Decision tools, like Bayesian networks, can help in these situations because they help organize thinking and information, provide a transparent record of the logic that led to a decision, and identify the important data gaps that, if filled, would improve future decision making. We have built decision analysis models for a variety of purposes, including predicting habitat suitability under climate change, exploring management alternatives for a threatened fish species, and making individual decisions about whether to remove or harden a fish passage barrier.

Staff

Administration & Facilities

Patty Crandell, Director
Roger Root, Deputy Director
Steve Dyer, Administrative Officer
Alina Nestjorkina, Administrative Assistant
Mark Hack, IT Specialist
Steve Money, Facility Operations Specialist
Jeff Poole, Water Treatment Plant Operator
Jim Lowell, Maintenance Worker

Conservation Genetics

Christian Smith, Regional Geneticist
Justin Bohling, Conservation Geneticist
Matt Smith, Conservation Geneticist
Brice Adams, Conservation Geneticist
Jennifer Von Bargen, Lab Geneticist
Matt Piteo, Biological Science Technician

Nutrition & Physiology

Ann Gannam, Regional Nutritionist
Ron Twibell, Acting Regional Physiologist
Richard Glenn, Microbiologist
John Holmes, Fish Biologist
James Barron, Fish Biologist
Kelli Hawke, Biological Science Technician
Racheal Headley, Biological Science Technician

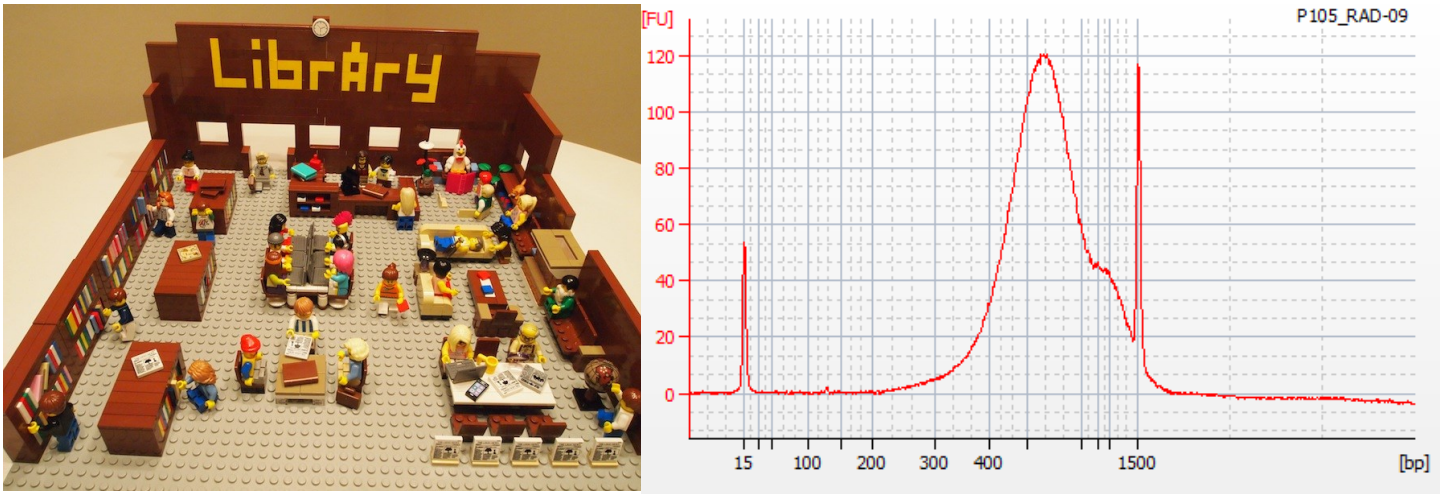
Quantitative Ecology & Technology

Doug Peterson, Senior Scientist
Ben Kennedy, Fish Ecologist
Kurt Steinke, Electronics Engineer
Katey Strailey, SCA Intern

Program Highlights

Conservation Genetics

Work on our laboratory benches has centered around building "genetic libraries", which are preparations of DNA or RNA, to be read on next-generation sequencing instruments. In the past two months, libraries were prepared for coho salmon from Hood Canal, WA, several species of suckers from the Klamath Basin, OR, Alvord chub from throughout their range in OR and NV, and steelhead from right here in Abernathy Creek. Each library processed on these instruments is expected to produce millions of DNA or RNA sequence reads, which is orders of magnitude more data than we were able to generate just a few years ago. The coho Salmon data will be used to evaluate populations of salmon adjacent to Quilcene NFH, the Alvord chub and Klamath sucker data will be used to determine distributions of genetic resources in these species, and the steelhead data will be used to answer questions about how specific hatchery practices impact the animals we release.



Top: Not a genetic Library. Bottom: Coho Salmon DNA library. The image is an output from a bioanalyzer which reveals the quantity (in Fluorescence Units; FU) of DNA present and the size of the fragments in the library (measured in basepairs; bp)

Abernathy FTC staff frequently receive requests for review of scientific or policy documents from other offices in the Pacific and Pacific Southwest Regions. These include study plans, final reports, and articles prepared internally by our partners, as well as potential recovery or listing actions for species listed under the Endangered Species Act. In the past two months, genetics staff have provided reviews of potential recovery actions for endangered Unarmored Threespine Stickleback, and endangered Sacramento River winter-run Chinook salmon, a Proposed Rule to Reclassify Borax Lake chub from endangered to threatened and environmental DNA (eDNA) protocols being applied by one of our partners.

The past two months represented the wrap-up of our 14th year of providing real-time genetic analyses to inform passage of bull trout above dams in the Clark Fork River. Some challenges arose which provided our staff and our partners with opportunities to demonstrate their dedication to this work. Extreme weather and fire events meant that FedEx was not able to deliver rapid-response samples to Abernathy FTC on time, and in each case our staff offered to change schedules, juggle projects and work extra hours to ensure we could provide results to our partners in time for them to release fish. In September, we faced an additional obstacle when the laser on our DNA sequencer burned-out, leaving us unable to process samples. Brice worked with Todd Seamons, Director of the Washington Department of Fish and Wildlife (WDFW) Molecular Genetics Laboratory, to use their equipment to complete analysis of bull trout while our sequencer was being repaired. Our programs routinely standardize data in order to allow sharing of resources, so the analysis was completed

Program Highlights— continued

Conservation Genetics (continued)

successfully and the results were sent out in time for bull trout to be released into their respective watersheds. We felt very fortunate to work with staff and partners who are so strongly committed to our shared goal of recovering bull trout.

Matt Kuo of Western Washington FWCO and Roger Root tag and collect genetic samples from juvenile steelhead trout. *Photo credit: FWS.*

Nutrition & Physiology

Ten feed samples were received from the hatcheries for the Fish Feed Quality Control (FFQC) program. As part of the routine analyses, feeds from the hatcheries were checked for rancidity. Ann wrote the feed memos which are sent to the hatchery and the feed mill. The fourth quarter FFQC report was disseminated to tribal, state and Pacific and Pacific Southwest Region hatchery partners. The purpose of the FFQC program is to ensure that fresh feed that meets the dietary requirements of the fish is used at our NFHs. The report gives analytical data concerning the proximate analysis (protein, lipid, moisture and ash) and rancidity of the sampled feeds.

By the end of October, John and Kelli had handled 84 coho salmon, 2 out of basin steelhead, and 2 cutthroat trout that have entered Abernathy FTC's holding ponds.

Results of the white sturgeon cortisol analysis were provided to Ken Lujan at Spring Creek NFH. The physiology program were asked to analyze cortisol levels in plasma samples collected from adult sturgeon. The samples were collected in response to die-offs in the Columbia River in 2013 and 2015. Plasma cortisol level can be used to assess the stress level of an animal.

In the second year of the coho salmon egg biochemical composition study, Katey, Racheal and Ron collected coho eggs at Quilcene NFH. These eggs along with coho eggs collected at Eagle Creek NFH will be analyzed for biochemical composition. The objective of this ongoing project is to examine the relationship between egg biochemical composition and reproductive success and to determine whether egg composition is influenced by ocean conditions. The information may help increase our understanding of how changes in ocean conditions may affect future NFH production.

James reviewed a manuscript for the journal Aquaculture Research.

Publications and Reports

Cunningham, C. J., T. A. Branch, T. H. Dann, M. Smith, J. E. Seeb, L. W. Seeb, and R. Hilborn. 2017. A General Model for Salmon Run Reconstruction That Accounts for Interception and Differences in Availability to Harvest. Canadian Journal of Fisheries and Aquatic Sciences. Online. doi: 10.1139/cjfas-2016-0360.

Piteo, M. S., M. R. Kendrick, and P. M. & Harris. 2017. Life History of *Labidesthes vanhyningi* (Atheriniformes: Atherinopsidae; Stout Silverside) in the Black Warrior River Drainage, Alabama. Southeastern Naturalist, 16(3), 451-463.

Twibell, R., Smith, C., Hanson, K., Glenn, R., Von Bargen, J. 2017. Determination of gill Na^+, K^+-ATPase enzyme activity and gene expression from juvenile steelhead reared at Lyons Ferry and Irrigon Fish Hatcheries. AFTC Final Report.

Program Highlights - continued

Nutrition & Physiology—continued

Technical assistance provided

Ann supplied Kirk (Joshua) Groves (based out of Klamath Falls FWO) with the compositional data obtained from the analysis of algae samples he sent. He is using these algae as a supplemental feed for Klamath Basin suckers held in earthen ponds.

Racheal and Ron, along with Kari Dammerman of the Columbia River FWCO, discussed the ongoing Abernathy FTC coho egg project with Joshua Etherton, Harvest Management Biologist with the Quileute Tribe. Joshua is interested in methods of quantifying reproductive success of coho spawned at Quileute tribal hatcheries.

Ann was contacted by Manuel Ulibarri, center director at the Southwestern Native Aquatic Resources & Recovery Center, about making small batches of custom feed to test calcein uptake from feed by Colorado Pikeminnows. Calcein is a fluorescent dye used, in this case, to mark fish. Morgan Brizendine from the San Marcos Aquatic Resources Center contacted Ann about algal products to use as feeds for the Devil's River Minnow (*Dionda diaboli*).

Ann provided information and specifications for feeds to Mike Crewson, Tulalip Tribes, to help with feed purchasing.

Ann was contacted by Ben Gilles, Manager at Makah NFH, for information about starter feeds for sturgeon, pallid and shovelnose, raised at Garrison Dam NFH. Correspondence continued with the hatchery manager, Rob Holm. The problem is inconsistent fish survival with the starter feed.

The Northwest Indian Fish Commission had a question about fish that appeared to start on feed and then, after about five weeks, start to drop out. Problem could be a nutritional deficiency or a feed size issue.

Ann was contacted by the Northwest Indian Fisheries Commission (Fish Health) about feed sizes used at the Stillaguamish Tribal Hatchery for the endangered Chinook raised at the facility. She also discussed the possibility of sharing the Fish Nutrition/Fish Health workshop presentations with audio with hatchery personnel.

Ann provided literature and information about probiotics to Mary Moser, NOAA Seattle Laboratory. She is interested to see if probiotics will benefit larval lamprey raised in recirculating systems.

Richard Glenn, James Barron, and Katey Strailey of Abernathy FTC and Matt Kuo of Western Washington FWCO electrofishing the lower multipass sampling site in Abernathy Creek. *Photo credit: FWS*

Quantitative Ecology & Technology (QET)

Ben and his field crew - which included staff from Abernathy FTC, Columbia River FWCO, and Western Washington FWCO - completed their annual survey of juvenile steelhead in Abernathy Creek, where they capture (and recapture) fish, collect biodata, and implant newly-captured steelhead with PIT tags to estimate survival and emigration rates. This year the crew captured 597 fish of which 152 were implanted with passive integrated transponder (PIT) tags. The work supports a multi-disciplinary study at Abernathy FTC that is investigating the relative reproductive success of hatchery steelhead and ecological differences between hatchery and wild fish. Surveys were suspended for a few days during the sampling because water temperatures were too high to capture and handle fish without inducing physiological stress or potentially causing mortality.

Program Highlights - continued

Quantitative Ecology & Technology (QET) - continued

Doug, Kelli, Will, and Katey traveled to Malheur NWR to begin setting up a large field experiment to inform management of non-native common carp. The study objective is to determine if there is a threshold for biomass of common carp at which submerged aquatic vegetation would begin to recover, because the complete eradication of carp is not feasible at this time. This threshold value would serve as a management target for control of common carp in Malheur Lake. Field crews installed 14 large (200 m^2) enclosures in Windmill Pond, in the Double O unit of Malheur NWR. Assisting were biologists from Malheur NWR and biological technicians from the Columbia River FWCO. In summer of 2018, the enclosures will be stocked with different densities of carp, and data on water quality and aquatic vegetation will be collected through the summer and early fall. Project collaborators include Malheur NWR and the Harney County Watershed Council, and funding is provided by the Oregon Watershed Enhancement Board.

Will, assisted by Katey, made multiple trips to the Umatilla River basin for electronic noise testing near two large PIT tag antenna arrays. With funding from Bureau of Reclamation (BOR), Abernathy FTC installed the arrays in the Umatilla River to monitor movement of juvenile Pacific lamprey and help determine the location and magnitude of entrainment at irrigation headgates. Both conducted and radiated electronic noise are affecting certain antennas, and the data collected will be used to design and implement mitigation strategies to improve the performance of affected antennas.

Doug met with Merra Howe who is completing an internship in Headquarters' Congressional Affairs office. Merra was visiting field stations in Region 6 and hopes to coordinate a congressional visit to Service field stations in 2018. Doug gave her a summary of the programs and type of research done at Abernathy FTC.

Enclosure construction in Windmill Pond – plastic sheeting is wrapped around the fence posts that delineate the enclosure. The sheeting is later anchored to the substrate so that fish cannot escape under the bottom. Photo Credit: FWS

Completed enclosures at one end of Windmill Pond. The sides of the enclosures have been lowered even with the water level in preparation for winter ice up. Each enclosure is 200 m^2. Photo Credit: FWS

(L to R) Katey Strailey, Will Simpson, Sean Fitzmaurice, and Doug Peterson installing carp enclosures at Windmill Pond in Malheur NWR. Photo Credit: FWS.

Program Highlights - continued

(L to R) Kelli Hawke and Chanice Davies moving supplies past completed enclosures in Windmill Pond in Malheur NWR. Photo Credit: FWS

QET—continued

Technical assistance provided

Kurt and Doug had a conference call with Damon Goodman, fish biologist with the Arcata FWO, to discuss upgrading their PIT system to monitor upstream passage of Pacific lamprey. Kurt is providing technical assistance on the use of newer readers, evaluation of existing antennas, design of new antennas, and system integration. Damon and a colleague will visit Abernathy FTC in December to get hands-on training.

Kurt, visited Kelsey Creek, WA, to help Roger Tabor (Western Washington FWCO) with a PIT antenna system to monitor movement of sculpin.

Doug and Kurt consulted with Chad Mellison in the Nevada FWO and are assisting him with design and construction of two PIT systems to monitor movement of a threatened frog species in a Nevada stream.

Staff Changes

Roger Root is officially the new Deputy Director at Abernathy FTC. Roger was recently reassigned to Abernathy FTC after working for over 14 years at the Ventura FWO, with the last ten years in leadership positions, and the last three years as Deputy Field Supervisor. Some of Roger's field experience includes conducting surveys for California red-legged frogs and steelhead as well as radio-collaring San Joaquin kit foxes and tracking them for studies using radio telemetry equipment. Roger brings his years of experience and education, including a M.S. degree from Cal Poly San Luis Obispo, to Abernathy FTC where his management and supervisory experience are needed and welcomed.

Will Simpson reassigned to Fish Biologist position at the Columbia River FWCO where he will supervise a group of biologists and technicians that specialize in detection of tagged fish. He will continue to work closely with staff at Abernathy FTC on current projects in coordination between stations. Good luck Will in your new position!

Outreach

Due to the increased interest in having live lamprey at outreach events and our desire to accommodate our partners, ***James Barron*** *has been designated the Point of Contact for obtaining the fish.*

Abernathy FTC supplied ammocoetes for the Sturgeon Festival held at the Water Resources Education Center in Vancouver, WA. There were approximately 500 attendees, and we understand the lamprey were a hit with the kids. Our ammocoetes attended another outreach event for the 4th Annual Westmoreland Park Salmon Celebration. Jeff Johnson from the Columbia River FWCO had the fish on exhibit at the event. About 360 people visited the FWS table and learned about lamprey as well as salmon and the Service.

James provided information to the Maureen Hosty, an OSU 4-H Extension Faculty member, about housing lamprey at the Native American Youth and Family Center (NAYA) in Portland. Maureen also extended an invitation for James and others to come to NAYA for an outreach event working with the Lamprey Ambassadors' program.

Ron gave a presentation on Abernathy FTC's history, mission and programs to the Lower Columbia Fly Fishers Club.

Pacific lamprey.

Meetings, Conferences and Trainings

- James, Ann and Ron joined Ben for the Fall Lamprey Technical Workgroup WebEx e-meeting.
- James, Ron and Ann participated in a conference call with Mary Moser, NOAA Fisheries and Ralph Lampman and Bob Rose both from the Yakama Nation. The presentations that we will give at the Lamprey Summit in December were discussed, information to disseminate and the approach were the topics.
- Ann participated in a conference call with the Fisheries and Aquatic Conservation Training and Employee Development Workgroup.
- Ann and Doug attended the FWCO meeting in Olympia, WA, and gave presentations summarizing work done by Nutrition & Physiology and QET programs at Abernathy FTC.
- Ben participated in regular conference calls of the Pacific Lamprey Conservation Team.
- Christian participated in the Region One Fisheries Database teleconference.
- Patty and Roger attended the annual FWCO and PL meetings at the Nisqually NWR in Olympia.
- Christian attended Civil Treatment for Leaders training.
- Brice and Justin participated in the 2017 *Salvelinus confluentus* Curiosity Society Meeting. The annual meeting provides an opportunity for us to share the results of our research on Bull Trout with state, private, and tribal partners. Brice delivered a presentation on the results of our work with Pacificorp on Bull Trout passage issues in the Lewis River, and Justin presented the results of our work with Columbia River Inter-Tribal Fish Commission and WDFW on development of shared genetic monitoring resources.

Ongoing Projects

Water velocity effects on salmon as reared in recirculating systems. *Management Need:* Determine the effects of water velocity on composition, growth, condition, and performance of juvenile PNW salmon as applied to recirculating systems in support of hatcheries in the Pacific Region considering the use of recirculating systems. *Partners:* Pacific Region National Fish Hatcheries, Fishery Resources Program via Fisheries Operations and Need System (FONS).

Diet development for Lost River and short nose suckers in the Klamath River Basin. *Management Need*: Determine dietary needs of listed populations to assist in recovery. *Partners*: Klamath Tribes, Klamath Falls FWO, California/Nevada FHC.

Development of diets and rearing techniques for the culture of Pacific lamprey, *Entosphenus tridentatus*. *Management Need*: Assist Tribal partners in developing methods for the artificial propagation of Pacific lamprey, a species of concern. *Partners*: Yakama Nation; NOAA Fisheries and Chelan PUD.

Pacific Region's Fish Feed Quality Control (FFQC) Program. *Management Need*: The FFQC Program, the only one of its kind in the FWS, provides quarterly monitoring of the quality of the commercially produced fish feeds used at Pacific and Pacific Southwest Regions' NFHs. Information is compiled on an annual basis and used in the development of the Pacific Region fish feed contract. *Partners:* Pacific and Pacific Southwest Region's NFHs, Oregon, Washington, Idaho, and Tribal fish hatcheries.

Natural reproductive success and demographic effects of hatchery-origin steelhead in Abernathy Creek, WA. *Management Need*: Provide information to help managers minimize differences between NOR and HOR fish. *Partners*: Bonneville Power Administration; Washington Department of Fish and Wildlife.

Aquatic Organism Passage (AOP) at remediated stream road crossings. *Management Need:* Assess the efficacy of genetic, direct capture, and remote sensing methods to verify fish passage through remediated culverts. *Partners*: US Forest Service, Trout Unlimited.

Climate change vulnerability assessments of Pacific Region National Fish Hatcheries. *Management Need:* An understanding of the anticipated habitat changes under different climate change scenarios provides managers with information to proactively respond to these conditions and their impact on NFHs. *Partners*: Pacific Region NFHs; Mid-Columbia River FRO; Fishery Resources Program via FONS.

Genetic run assignment of juvenile Chinook salmon from the American River. *Management Need:* Assess accuracy of length-at-date method for distinguishing Spring run (ESA listed) from Fall run (unlisted) Chinook salmon smolts. *Partner:* Pacific Southwest Regional Office.

Entrainment and bypass of ESA-listed salmon at irrigation diversions on the Umatilla River. *Management need*: Determine what environmental factors influence the magnitude of fish entrainment into irrigation canals and if captured fish are successfully screened and returned to the Umatilla River using PIT tag technology. *Partner*: Bureau of Reclamation, Columbia River FWCO.

Design and installation of a PIT tag array to monitor outmigration of juvenile Pacific lamprey in the Umatilla River. *Management need:* Determine entrainment rates of juvenile lamprey as they move downstream through the Umatilla River. *Partners:* NOAA-Fisheries, U.S. Bureau of Reclamation, Columbia River FWCO.

Remote PIT system to monitor movement of Columbia spotted frog in a Nevada stream. *Management need:* Contributes to ongoing monitoring and conservation efforts for the Toiyabe subpopulation of the Columbia spotted frog (*Rana luteiventris*) in Indian Creek, in central Nevada. The data collected by the PIT arrays supports implementation of the Conservation Agreement and Strategy for this subpopulation. *Partners:* Nevada FWCO.

Genetic identification of endangered winter-run Chinook salmon in the Sacramento River, CA. *Management Need:* Rapid response broodstock identificaonfor spawning of listed species. *Partners:* Livingston Stone NFH; Red Bluff FWO; NOAA Fisheries.

Genetic analysis of bull trout in the Lewis River system. *Management Need:* Facilitate passage of bull trout past hydroelectric facilities. *Partners:* Washington FWO, Columbia River FPO, PacifiCorp, U.S. Forest Service, Washington Department of Fish and Wildlife.

Relative reproductive success of hatchery and wild steelhead in the Deschutes River basin. *Management Need:* Develop genetic markers to monitor genetic diversity of listed populations. *Partners:* Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, Columbia River Intertribal Fish Commission.

Genetic needs assessment for endangered Lost River and short nose suckers of the Klamath River Basin, OR. *Management Need:* Develop genetic markers to monitor genetic diversity of listed populations. *Partners:* Klamath Falls FWO, U.S. Geological Survey.

Evaluation of a poly-culture method for larval Pacific lamprey (*Entosphenus tridentatus*) using the effluent from PNW salmon hatcheries. *Management need:* Contribute to the recovery of the Pacific lamprey in the Pacific Northwest. The innovative rearing method developed could be implemented at any existing salmonid hatchery in the region, without using any additional water resources. Effluent nutrients could be sequestered by lamprey at these facilities. *Partners*: Fishery Resources Program via FONS.

Ongoing Projects—continued

Genetic assessment of bull trout in the Upper Willamette River, OR. *Management need:* Provides genetic information relevant to assessing the conservation status of the species and fish passage. *Partners:* Oregon Department of Fish and Wildlife.

Population genetic structure of Alvord Chub and relation to Borax Chub. *Management need:* Population structure information needed to inform listing decisions and recovery planning. *Partners:* USBLM, NDOW, ODFW, OSU.

Bull trout SNP marker discovery using RAD-seq. *Management need*: Identify a standardized panel of SNP genetic markers that can be applied to population genetics studies across the species' range. *Partners:* Washington Department of Fish and Wildlife, Columbia River Inter-Tribal Fish Commission.

Evaluating population structure and effective population size of redband trout in the Deschutes River, OR. *Management need:* Genetic data will help identify management units for redband trout in the Deschutes River basin. *Partners:* Oregon Department of Fish and Wildlife.

Population structure of coastal cutthroat trout inhabiting urban watersheds in Portland, OR. *Management Need:* Compare the characteristics of urban populations with their non-urban counterparts. *Partner:* Columbia River FWCO.

Genetic profile of Hood Canal coho salmon populations using RAD sequencing. *Management need:* Assess differentiation between wild coho salmon populations and the genetic impact of hatchery stocks. *Partners:* Northwest Watershed Institute, Quilcene National Fish Hatchery, Washington Department of Fish and Wildlife.

Mitochondrial Genome Sequencing for Conservation Applications. *Management Need:* Develop reference mitochondrial genomes for species of interest to be used for genetic marker development and the assessment of conservation units. *Partners: FWS Southwest, Midwest, Southeast, Northeast, Mountain-Prairie, Alaska and Southwest Regions.*

Genetic profiles of broodstock at Pacific Region National Fish Hatcheries. *Management Need:* Determine impacts of hatchery origin fish (HOR) on naturally occurring fish (NOR) and monitor the effects of aquaculture practices on HOR populations. *Partners:* Pacific Region NFHs, Fishery Resources Program via FONS.

Common carp biomass threshold experiment in Malheur Lake. *Management need:* Determine the common carp biomass below which aquatic plants can grow; this biomass would be the target biomass for suppression of carp in Malheur Lake. *Partners:* Malheur National Wildlife Refuge, Harney County Watershed Council, Oregon Watershed Enhancement Board

Effects of the Hagerman National Fish Hatchery water reuse system on steelhead physiology. *Management Need:* Evaluate the physiological status (body composition, seawater readiness) of steelhead reared in a partial reuse aquaculture system (PRAS) at a National Fish Hatchery. Partners: Idaho Department of Fish and Game, Idaho Fish and Wildlife Office, Pacific Region National Fish Hatcheries.

Effects of ocean conditions on coho salmon egg quality at two National Fish Hatcheries. *Management Need*: Examine the relationship between salmon egg biochemical composition and reproductive success and determine whether ocean conditions influence egg composition. Partners: Pacific Region National Fish Hatcheries.

Investigate differences in adult returns of steelhead reared in two hatcheries. *Management Need*: Determine whether physiological status plays a role in different adult return rates at two Lower Snake River Compensation Plan Hatcheries. Partners: Idaho Fish and Wildlife Office, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife.

Influence of feed ration on physiology of fall Chinook salmon. *Management Need***:** Determine whether feeding rate affects precocial male maturation rates, seawater adaptation and adult returns of fall Chinook salmon reared at Willard National Fish Hatchery. Partners: Columbia River Fish and Wildlife Conservation Office, Pacific Region National Fish Hatcheries.

Evaluating PIT tag loss in partial reuse aquaculture systems (PRAS) at Hagerman NFH. *Management need:* Determine if steelhead reared in RAS tanks shed their PIT tags at a higher rate than those reared in traditional raceways so that survival estimates are not biased by unrecorded tag loss. *Partners:* Hagerman NFH, Lower Snake River Compensation Plan, Idaho FWCO

Population structure and genetic stock identification of Icicle Creek Bull Trout. *Management need:* We require information on the origins of Bull Trout impacted by the operation of Leavenworth NFH. *Partner:* Mid Columbia FWCO.

Rapid Response Genetic Analysis of Bull Trout Collected at Clear Creek Dam, WA. *Management need:* Population of origin information needed to facilitate fish passage. *Partners:* WDFW, Mid Columbia FWCO.

Use of Genetic Analysis to Determine Origins of Prickly Sculpin Populations in Nisqually River Basin. *Management Need:* Evaluate the use of genetic tools to identify origin of an introduced population. *Partner:* Western Washington FWCO.